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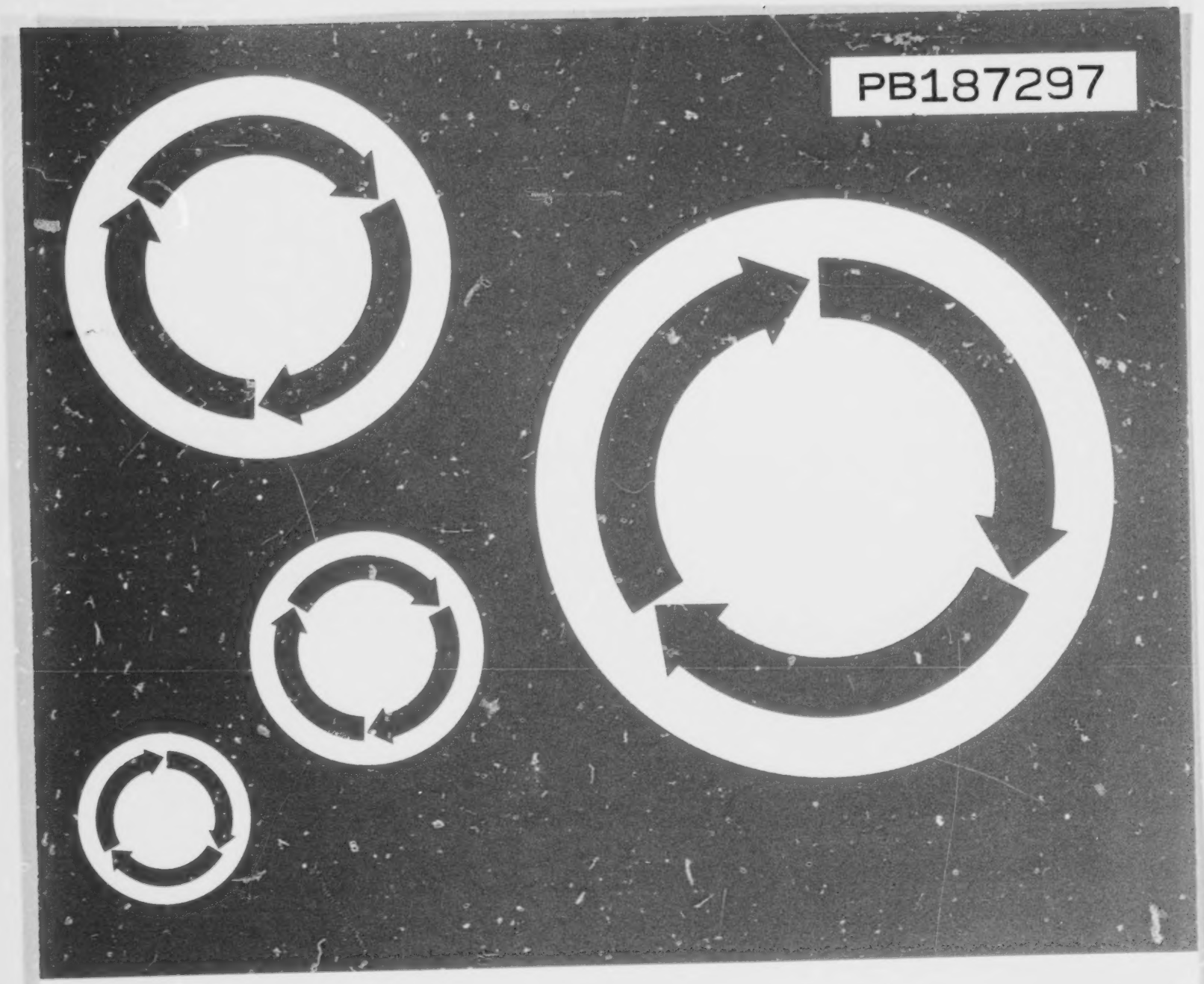

Summaries of Solid Wastes Program

CONTRACTS

July 1, 1965—June 30, 1968

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Consumer Protection and Environmental Health Service

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PB-187 297

SUMMARIES OF SOLID WASTES PROGRAM

CONTRACTS

July 1, 1965—June 30, 1968

Clarence A. Clemons and *Ralph J. Black*

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
CONSUMER PROTECTION AND ENVIRONMENTAL HEALTH SERVICE
ENVIRONMENTAL CONTROL ADMINISTRATION
Bureau of Solid Waste Management
1969

Public Health Service Publication No. 1897

Requests for technical information related to specific contracts should be addressed to the Bureau of Solid Waste Management, Environmental Control Administration, at either 12720 Twinbrook Parkway, Rockville, Md. 20852 (Telephone 301/496/8701), or 222 East Central Parkway, Cincinnati, Ohio 45202 (Telephone 513/684/3593). Requests for published information should be addressed to the Bureau of Solid Waste Management, 222 East Central Parkway, Cincinnati, Ohio 45202, or to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

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FOREWORD

THE CONTRACT MECHANISM is an integral arm of the Bureau of Solid Waste Management. Technical investigations and research are, of course, conducted by the Bureau's own staff. But this staff cannot be the size required for carrying on all the research and studies needed for solutions to the Nation's problems of managing its solid wastes. While capabilities of universities and other nonprofit organizations are being tapped through research grants as well as other types of grants,[1-4] contracts make it possible to use the accumulated practical experience and trained staffs of business and professional consultants.

Contracts are administered by means of regular written reports and oral discussion on a basis comparable to the review of work performed within the Bureau itself. This helps to ensure that the contract research fully meets the study intent. At the same time it keeps the Bureau staff informed on research progress and findings as they develop.

It is also important that the research world and the public at large learn of the results of contract investigations. Although a full report on each contract is usually published upon conclusion of the work, there is a legitimate demand for publication of prospectuses of the contracts and any information that can be made available on contract progress.

The present compilation (*SW–5*) is intended to satisfy that need. It contains abstracts on the 42 contracts undertaken from the beginning of activities conducted with funds appropriated under the Solid Waste Disposal Act through June 1968. In the initial stages many of the subjects for study were suggested by applicants and led to unsolicited contracts. As more detailed information was developed, it became easier to pinpoint gaps in our solid wastes knowledge, and therefore to utilize contracts that are directed toward meeting these deficiencies.

Thus far, subjects range from appraisals of current solid waste practices in Western Europe and this country to the development of a new solid waste technology. The variety and extent of subject matter defies easy characterization and can be judged only by a look at the table of contents.

The contracts described in this publication, as well as other contracts planned, hold great promise of extending the field of knowledge on solid waste management and at the same time of promoting a fruitful business–government partnership for research.

—RICHARD D. VAUGHAN, *Director*
Bureau of Solid Waste Management

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[1] LEFKE, L. W., comp. *Summaries of solid wastes research and training grants, 1968.* Public Health Service Publication No. 1596. Washington, U.S. Government Printing Office, 1968. 48 p.

[2] SPONAGLE, C. E. *Summaries; solid wastes demonstration grant projects—1968.* Public Health Service Publication No. 1821. Washington, U.S. Government Printing Office, 1968. 90 p.

[3] SPONAGLE, C. E. *Solid wastes demonstration grant abstracts; grants awarded January 1–June 30, 1968.* Cincinnati, U.S. Department of Health, Education, and Welfare, 1968. 57 p.

[4] SWAVELY, D. D., and L. F. HULTGREN. *State/Interstate solid waste planning grants; progress abstracts, January 1969.* Public Health Service Publication No. 1913. Washington, U.S. Government Printing Office, 1969. 94 p.

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SUMMARIES OF SOLID WASTES PROGRAM

CONTRACTS

July 1, 1965—June 30, 1968

THIS IS A COMPENDIUM of those projects supported by the Federal solid wastes program (now the Bureau of Solid Waste Management) since the passage of the Solid Waste Disposal Act of 1965. The purpose of the publication is to inform interested readers of the variety of contracts being supported, in such a way that information developed from this activity can be made quickly available and disseminated to those persons who can best use the information. We hope that the publication may stimulate prospective contractors to conceive new approaches, which, through research and development, will lead to and advancement of technology and to better methods of solid waste management.

The Solid Waste Disposal Act of 1965 directs the Secretary of the Department of Health, Education, and Welfare to conduct, encourage, cooperate with, and assist appropriate public authorities, agencies, and institutions, private agencies, institutions, and individuals in the conduct of, and promotion or coordination of, research, training, demonstrations, surveys, and other studies relating to the operation and financing of solid waste disposal programs, the development and application of new and improved methods of solid waste disposal, and the reduction of the amounts of such waste and unsalvageable waste materials.

In this regard the Secretary is authorized to: (1) collect and make available through publishing the results of such research; (2) cooperate with public and private agencies, institutions, and with any industries involved in the preparation and the conduct of such research; (3) make grants-in-aid and contracts with public or private agencies and institutions, and to individuals for research, training projects, surveys, and demonstrations.

Any grant, agreement, or contract made or entered into is to contain provisions effective to ensure that all information, uses, processes, patents, and other developments resulting from any activity undertaken pursuant to such grant, agreement, or contract will be made readily available on fair and equitable terms to those industries utilizing methods of solid waste disposal and to industries engaging in furnishing devices, facilities, equipment, and supplies to be used in connection with solid waste disposal.

The summaries, arranged alphabetically by contractor, represent the efforts made to carry out this contract authority. One can readily see that there is no single approach applicable to the wide variety of solid wastes produced and that, as the concept of solid waste management has developed, so has the scope of our contracts. The characteristics of solid wastes are continually changing through product innovations, industrial process modification, and changes in living habits of the general population. Storage, collection, transport, processing, utilization, and disposal practices must continually be modified to keep pace with these changes.

Research contracts are conducted as a separate operation within the Bureau of Solid Waste Management to implement the directed research efforts of the Solid Waste Disposal Act. The contract mechanism makes it possible to support projects for which neither staff nor equipment is available. This mechanism permits the national program to utilize specialized facilities, organizations, and capabilities wherever they may exist. A contract may be a separate project in itself or may complement in-house research.

Solicited contracts are awarded to qualified contractors who submit the best proposals in

response to advertised requests as they appear in the *Commerce Business Daily*. This competitive mechanism is used to ensure that the work required will be performed in the most economical manner by those best qualified.

Profit and nonprofit organizations desiring to perform research within the scope and intent of the Solid Waste Disposal Act are invited to submit proposals for consideration. All proposals submitted are evaluated for technical contribution and program relevancy, and compete with other proposals, both solicited and unsolicited, for priority funding.

A format, selected to enable the reader to become aware of the actual content of resultant publications, includes the objectives, the approach used, and a summary of progress for each contract.

—RALPH J. BLACK

LITERATURE SURVEY OF PUBLIC HEALTH AS RELATED TO SOLID WASTES

CONTRACT NO. PH 86-66-151

CONTRACTOR
Aerojet-General Corp.
1100 West Hollyvale Street
Azusa, Calif. 91202

COST: $59,310
PROJECT START: JUNE 1966
PROJECT END: JANUARY 1967

PROJECT DIRECTOR
Thrift G. Hanks

OBJECTIVE: To obtain a thorough and consistent listing and evaluation of health problems reported to be associated with solid waste disposal by identifying the relationships between human health and solid waste management.

APPROACH: The contract was primarily concerned with those relationships resulting in disease processes. A survey of the technical world literature was made: (1) to identify types, sources, disease processes, and occupational descriptions; (2) to accumulate data and establish identifiable relationships; (3) to note and tabulate significant conclusions and recommendations; (4) to provide an annotated bibliography of related survey literature; (5) to organize and publish a survey report on the public health aspects of solid waste handling and disposal.

SUMMARY OF PROGRESS: A report on the comprehensive literature survey, *Solid Waste/Disease Relationships,* was published. In this report each postulated solid waste/disease relationship is presented as follows: (1) a general statement on the disease under consideration; (2) a postulation on its association with wastes; (3) the evidence found in the literature supporting this postulation; (4) discussion of the evidence; (5) conclusions relative to the disease/waste association and to possible projections of the observations; (6) recommendations for research or other action.

HANKS, T. G. *Solid waste/disease relationships; a literature survey.* Public Health Service Publication No. 999-UIH-6. Washington, U.S. Government Printing Office, 1967. 179 p. Reprinted 1968.

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AN IDENTIFICATION PROGRAM FOR SOLID WASTES RESEARCH

CONTRACT NO. PH 86-67-126

CONTRACTOR
Aerojet-General Corp.
Life Science Division
1100 West Hollyvale Street
Azusa, Calif. 91702

COST: $19,500 (estimated)
PROJECT START: May 1967
PROJECT END: August 1967

PROJECT DIRECTOR
Thrift G. Hanks

OBJECTIVE: To develop a system for assigning priorities to selected research and development projects related to solid waste and public health problems.

APPROACH: A study of solid waste/disease relationships revealed research needs in a number of important areas. A detailed evaluation and assignment of priorities to those areas, however, was beyond the scope of that study. This research program was designed to select the most important topics from that report and to develop a series of task descriptions for specific research and development projects. Cost estimates as well as work statements, a description of the specific problem and its background, and an outline of a program devoted to its solution were included for the 10 most important projects.

SUMMARY OF PROGRESS: The final report on a solid waste research identification program has been accepted. The report, designed for in-house use, describes in detail the rationale and methods used, the various ratings obtained, conclusions, recommendations, work statements, and a basic research program outline.

DEVELOPMENT OF TRAINING COURSES, AIDS, AND A TRAINING PROGRAM FOR PUBLIC WORKS OFFICIALS

CONTRACT NO. PH 86–66–146

CONTRACTOR
American Public Works Assoc.
1313 East 60th Street
Chicago, Ill. 60637

COST: $86,523
PROJECT START: June 1966
PROJECT END: July 1968

PROJECT DIRECTOR
Robert D. Bugher

OBJECTIVE: To develop a package of training courses for those operators, managers, and public works officials concerned with various aspects of solid waste management that can be used to broaden solid waste training throughout the Nation.

APPROACH: A comprehensive blueprint for the training of personnel in the field of solid waste management will be prepared. This will include fully developed courses previously tested in pilot programs, a fully developed curriculum tailored to existing needs, and well developed teaching methodology including instructions for the use of training aids. Consideration will be given to the educational backgrounds, work experiences, and career goals of operating officials, the requirements and responsibilities of the positions, and the socio-economic and technical trends most likely to alter the function of operating personnel.

SUMMARY OF PROGRESS: Course outlines have been prepared and pilot courses have been conducted on the following: (1) incinerator plant operation; (2) sanitary landfill operation; (3) solid waste management; (4) refuse collection; (5) solid wastes technology; (6) solid waste management policy. Pilot courses have been given in six major cities. Each course has been designed for individuals who manage specific activities in solid waste collection and disposal programs or who are responsible for policy, administration, and technical decision affecting such programs. Some model operations have been selected for demonstration purposes. Additional information concerning the training courses can be obtained from the American Public Works Association.

STATUS OF UNIT OPERATIONS AND PROCESSES FOR SOLID WASTE DISPOSAL

CONTRACT NO. PH 86-66-160

CONTRACTOR
Battelle Memorial Institute
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

COST: $57,265 (estimated)
PROJECT START: June 1966
PROJECT END: February 1967

PROJECT DIRECTOR
Richard B. Engdahl

OBJECTIVE: To assemble all available information on solid waste processing in order to provide a concise reference useful to those concerned with the development of new and improved processes.

APPROACH: Information on the reliability of the processes, performance data, economic factors, and range of pertinent commercially available equipment and devices was obtained by surveying and examining existing technical processes and techniques. This included both industrial and municipal applications with evaluations as to applicability to solid waste treatment. The general processes considered were (1) densification and size reduction; (2) separation; (3) recovery and utilization; (4) chemical processing. Special problems such as health hazards and environmental pollution were to be examined.

SUMMARY OF PROGRESS: A report on the status of unit operations and processes for solid waste disposal has been accepted. The report summarizes the present status of methods now or recently in use for the disposal and utilization of solid wastes. The report shows that although a few aspects of solid waste processing are well developed, the availability of economic methods for most solid waste problems is scarce or nonexistent. The summary is organized under four general headings into which the study is divided. The report will be published.

ENGDAHL, R. B. *Solid waste processing; a state-of-the-art report on unit operations and processes.* Public Health Service Publication No. 1856. Washington, U.S. Government Printing Office, 1969. (In press.)

EVALUATION OF METHODS OF SOLID WASTE SEPARATION, RECOVERY, OR DISPOSAL

CONTRACT NO. PH 86-67-265

CONTRACTOR
Battelle Memorial Institute
505 King Avenue
Columbus, Ohio 43201

COST: $76,650 (estimated)
PROJECT START: June 1967
PROJECT END: August 1968

PROJECT DIRECTOR
Robert F. Testin

OBJECTIVE: To investigate, evaluate, and document separation and recovery equipment, processes, and techniques that have potential application in the areas of solid waste separation and utilization.

APPROACH: The investigation involved a study to establish the range of expected characterization of solid wastes, including total amounts, and physical and chemical properties. A literature survey, solicitations to manufacturers, and analyses of existing reclamation and disposal plants were used to compile a list of equipment and techniques and to assess their applicability to various types of solid wastes. For each unit process considered, appropriate operating information was compiled, and effects of input characteristics on capital and operating costs and the output products and any synergistic or antagonistic effects of various processes on one another were assessed. Information was obtained to define process capabilities, reliability, economics, availability of commercial equipment, and special operational problems. Appropriate mathematical, statistical, and economic methods were used to develop capital and operation cost relationships as functions of input and output characteristics.

SUMMARY OF PROGRESS: The final report is completed. The expected characteristics of solid wastes, including the amounts and physical and chemical properties, have been tabulated. Through literature surveys, solicitations from manufacturers, and analyses of existing reclamation and disposal plants, the list of techniques and equipment has been compiled. The applicability of selected equipment and processes to the solid waste field has been assessed. Process capabilities, reliability, economics, availability of commercial equipment, special operational problems, and health hazards have been defined. Using appropriate mathematical, statistical and economic methods, capital and operating cost relationships have been developed. Feasible combinations of processes or equipment have been suggested. The report will be published.

DROBNY, N. L., H. E. HULL, and R. F. TESTIN. *Recovery and utilization of municipal solid waste; a summary of available cost and performance characteristics of unit processes and systems.* Public Health Service Publication No. 1908. Washington, U.S. Government Printing Office, 1969. (In press.)

A STUDY OF IMPROVED METHODS FOR DISMANTLING RAILROAD FREIGHT CARS

CONTRACT NO. PH 86-67-100

CONTRACTOR
Booz, Allen Applied Research Inc.
4733 Bethesda Avenue
Bethesda, Md. 20014

COST: $50,000
PROJECT START: March 1967
PROJECT END: December 1967

PROJECT DIRECTOR
Dale M Butler

OBJECTIVE: To encourage the development of new and improved methods of railroad car dismantling and salvage operations that permit reuse of waste materials without presenting environmental problems.

APPROACH: On-site observations and interviews with key personnel were used to study current operating practices of railroad car dismantlers throughout the country, and to summarize information on proposed new techniques. Feasibility studies on new techniques that promise acceptable pollution control and economic practicality were investigated. A system for rating proposed car dismantling systems in order to select the best method for prototype development was undertaken.

SUMMARY OF PROGRESS: A final report containing the findings, conclusions, and recommendations has been accepted and is being published.

In effect the study was a pilot application of the systems approach to the difficult and complex problems presented by pollution and effective resource utilization. Many aspects of developing technology were investigated including new forms of explosives, high-speed water jets, cryogenic brittilizing agents, and advanced methods in wood utilization. Two approaches were suggested for prototype development: a system of cutting wood from railroad cars using high-pressure, manually operated water jets, and a system of using the car itself for an incinerator with a stack installed directly on the car to control effluent emissions.

BUTLER, D. M., and W. M. GRAHAM. *Dismantling railroad freight cars; a study of improved methods with application to other industrial demolition problems.* Public Health Service Publication No. 1850. Washington, U. S. Government Printing Office, 1969. (In press.)

TECHNICAL–ECONOMIC STUDY OF SOLID WASTE DISPOSAL NEEDS AND PRACTICES

CONTRACT NO. PH 86–66–163

CONTRACTOR
Combustion Engineering, Inc.
New Products Division
1000 Prospect Hill Road
Windsor, Conn. 06095

COST: $156,375 (estimated)
PROJECT START: June 1966
PROJECT END: November 1967

PROJECT DIRECTOR
Elliot D. Ranard

OBJECTIVE: To obtain data on: (1) disposal costs for municipal and industrial solid wastes with the additional costs that will be required to meet disposal standards which prevent land, water, and air pollution; (2) relative importance of such variables as technical developments, population movements, living habits, etc., that affect the composition and quantity of solid wastes; (3) reliable techniques and models for predicting collection and disposal facility needs.

APPROACH: Through surveys and personal interviews in selected U.S. cities, in-depth studies on municipal and industrial solid waste practices were undertaken in order to obtain installed capacity of refuse disposal facilities, estimates of the production of industrial solid wastes, and projections for generation and capacities in selected areas to 1975. Mathematical models to predict requirements for waste reduction facilities and refuse production were developed. The contractor also analyzed the problems relative to a refuse sampling and information system and gathered and analyzed data to describe the operational situations and information input and output.

SUMMARY OF PROGRESS: A four-volume report was accepted by the Bureau of Solid Waste Management and selected sections will be published. *Municipal Inventory* presents surveys made of various cities to obtain data on amounts and types of waste generated, with a mathematical model for the Nation that predicts future amounts of solid wastes that will be generated. *Industrial Inventory* presents results of a survey of 23 industries indicating the disposal techniques used. *Information System* emphasizes the need for a solid waste information system to aid municipalities in planning refuse disposal plants. *Technical–Economic Overview* presents an overview of waste management systems based on in-depth interviews in a selected number of cities.

COMBUSTION ENGINEERING, INC. *Technical–economic study of solid waste disposal needs and practices.* Public Health Service Publication No. 1886. Washington, U.S. Government Printing Office, 1969. (In press.)

(*Continued on page 10*).

ADDITIONAL PUBLICATIONS RESULTING FROM CONTRACT NO. PH 86-66-163

BACHER, J. H., and E. D. RANARD. Use of mathematical planning models to predict incineration requirements. In *Proceedings, 1968 National Incinerator Conference*, New York, May 5–8, 1968, American Society of Mechanical Engineers. p. 1–11.

COHAN, L. J., and J. H. FERNANDES. Potential energy-conversion aspects of refuse. Paper presented at the Eighty-eighth Winter Annual Meeting of the American Society of Mechanical Engineers, Pittsburgh, Nov. 12–17, 1967. 7 p.

FERNANDES, J. H. Incinerator air pollution control. In *Proceedings, 1968 National Incinerator Conference*, New York, May 5–8, 1968, American Society of Mechanical Engineers. p. 101–116.

KALIKA, P. W. The effects of variations in municipal refuse on some incinerator design parameters. Paper presented at the Eighty-eighth Winter Annual Meeting of the American Society of Mechanical Engineers, Pittsburgh, Nov. 12–17, 1967. 10 p.

KALIKA, P. W. Influence coefficients to relate municipal refuse variations to incinerator design. In *Proceedings, 1968 National Incinerator Conference*, New York, May 5–8, 1968, American Society of Mechanical Engineers. p. 154–170.

FEASIBILITY STUDY FOR APPLYING JET ENGINE TECHNOLOGY TO REFUSE INCINERATION

CONTRACT NO. PH 86-67-259

CONTRACTOR
Combustion Power Company, Inc.
(formerly Aerospace Commercial Corporation)
Stanford Industrial Park
2625 Hanover Street
Palo Alto, Calif. 94304

COST: $134,000 (estimated)
PROJECT START: June 1967
PROJECT END: June 1968

PROJECT DIRECTOR
Richard D. Smith

OBJECTIVE: To determine the technological and economic feasibility of a system of solid waste incineration that utilizes waste heat to generate electric power through a jet turbine.

APPROACH: Engineering studies were conducted as necessary to investigate use of a standard jet engine to receive the cleaned gases from the incineration of solid wastes. Separate studies were required to determine the effects of chemical composition, products of combustion, and heating values. In addition, surveys were conducted on shredders, preheat feeders, and separators to obtain equipment suitable for use with the refuse combustor.

SUMMARY OF PROGRESS: A technical abstract on the feasibility study is being reviewed. The results of the study seem to indicate that the project is technically feasible and economically attractive. An additional contract to conduct key subscale experiments for several components of the jet turbine incinerator has been awarded [see: Subscale experiments on the model 400 combustion power unit (CPU-400), Contract No. PH 86-68-188.]

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SUBSCALE EXPERIMENTS ON THE MODEL–400 COMBUSTION POWER UNIT (CPU–400)

CONTRACT NO. PH 86–68–198

CONTRACTOR
Combustion Power Company, Inc.
Stanford Industrial Park
2625 Hanover Street
Palo Alto, Calif. 94304

COST: $331,810 (estimated)
PROJECT START: June 1968
PROJECT END: December 1968
Extended to: June 1969

PROJECT DIRECTOR
Richard D. Smith

OBJECTIVE: The objective of this contract is to build and test subscale models of various combustor and particle collector devices to obtain necessary information for final design for the CPU–400 system. The CPU–400 system makes use of a jet aircraft engine powered by the waste heat from incineration of refuse for the purpose of generating electricity.

APPROACH: The contractor will subcontract the various tasks associated with this effort. These include basic high-pressure combustion experiments; fluid bed and gasifier experiments; analysis of combustion products; design, fabrication and delivery of a subscale separator, electrostatic precipitator, and mat filter; design, fabrication, and checkout of a hot gas and particle generator; testing and evaluation of all three subscale particle separators; description of an experimental program and conduct of particle analyses. The results of these tests will form the basis for the choice of the particle collector and combustor to be used for the CPU–400.

SYSTEMS ANALYSIS OF SOLID WASTE DISPOSAL

CONTRACT NO. PH 86-67-254

CONTRACTOR
Cornell Aeronautical
Laboratories, Inc.
Post Office Box 235
Buffalo, N.Y. 14221

COST: $98,515 (estimated)
PROJECT START: June 1967
PROJECT END: August 1968
Extended to: January 1969

PROJECT DIRECTOR
Edwin W. Roth

OBJECTIVE: To develop a mathematical model for determining the overall costs and effectiveness of alternate waste disposal systems within a regional solid wastes system.

APPROACH: The contractor will collect and analyze existing regional data, identify indirect social costs, and establish a realistic range of constraints on deleterious effects. With this data and related background information, a mathematical model of politically realistic regional solid waste systems, which computes overall costs and performance, will be formulated. The major output of the study will be a first definition of a model or simulational method and its implementation. The model will be used to prepare a program for future work centered around comprehensive utilization of the developed model with an expansion and refinement of the model structure.

SUMMARY OF PROGRESS: The Buffalo, N.Y., region was selected to serve as a normative basis for a mathematical model of solid waste management. The inputs are for the year 1966. A method for dealing with deleterious effects was chosen and a general outline of the first generation mathematical model was developed. Analytical and statistical representations of the region, its solid waste producers and production rates, types of waste, existing waste disposal facilities, etc., were made for the computer simulation of the regional waste disposal system, and the model is being generalized so that it can be adjusted for use with any metropolitan region. The period from November 1, 1968, to January 31, 1969, was devoted to the preparation and completion of the final report, which is now being considered for publication.

PRODUCTION OF A MOTION PICTURE FILM ON SOLID WASTE DISPOSAL

CONTRACT NO. PH OS-DQ-66-109

CONTRACTOR
County Sanitation Districts of Los Angeles County
Solid Wastes Engineering Section
2020 Beverly Boulevard
Los Angeles, Calif. 90057

COST: $10,500 (estimated)
PROJECT START: June 1966
PROJECT END: September 1968

PROJECT DIRECTOR
John D. Parkhurst

OBJECTIVE: To use audiovisual media for communicating basic knowledge of sanitary landfilling techniques and guidelines for acceptable disposal of urban solid wastes.

APPROACH: Locations and descriptive narratives were chosen to describe successful landfill techniques. Sections of the film are devoted to site selection, equipment requirements, climate influences, operating procedures, topography and soil conditions, storm drainage, final contour planning, and ultimate use of the completed fill.

SUMMARY OF PROGRESS: A 16-mm motion picture film in color with sound, approximately 30 minutes in length, entitled *Sanitary Landfill: One Part Earth to Four Parts Refuse,* has been submitted in fulfillment of the contract. The film covers all aspects of landfill planning and operation. Copies of the film will be available from the Office of Information, Bureau of Solid Waste Management, for public showing to interested groups or organizations. Supporting publications include a promotional flyer and a brochure containing line drawings and a written version of the film narrative.

OCEANIC DISPOSAL OF SOLID WASTES AND INDUSTRIAL SLUDGES FROM 16 U.S. COASTAL CITIES

CONTRACT NO. PH 86-68-203

CONTRACTOR
Dillingham Corporation
Applied Oceanography Branch
11803 Sorrento Valley Road
San Diego, Calif. 92121

COST: $50,000 (estimated)
PROJECT START: June 1968
PROJECT END: June 1969

PROJECT DIRECTOR
David D. Smith

OBJECTIVE: To determine the nature and magnitude of present oceanic disposal practices with the current or potential hazards to public health.

APPROACH: Interviews with port captains, harbor police, industrial concerns, tug and barge contractors, appropriate private individuals, and such nonhostile sources as may be developed, will be used in on-site surveys of the following cities:

Baltimore, Maryland
Beaumont–Port Arthur, Texas
Boston, Massachusetts
Charleston, South Carolina
Galveston–Texas City–Houston, Texas
Los Angeles–Long Beach, California
New Orleans, Louisiana
New York City, New York
Norfolk, Virginia
Philadelphia–Wilmington, Pennsylvania
Portland, Oregon
St. Petersburg, Florida
San Diego, California
San Francisco, California
San Juan, Puerto Rico
Seattle, Washington

The information thus collected will be compiled, summarized, and evaluated by a team of marine biologists, oceanographers, and sanitary engineers; from this information, the present or potential effects that may be detrimental to community aesthetics or to public health will be determined for the presently known ocean-disposal activities.

BROWN, R. P., D. D. SMITH, and C. G. GUNNERSON. Status of oceanic disposal of solid wastes—a preliminary review. Presented at Man and His Environment, Fifteenth Annual Meeting, The Institute for Environmental Sciences, Anaheim, California, Apr. 20–24, 1969.

GUNNERSON, C. G., R. P. BROWN, and D. D. SMITH. Marine disposal of solid wastes. To be presented at Environmental Engineering for the Ocean and the Continental Shelf, Miami Beach, Dec. 10–12, 1969. American Society of Civil Engineers.

STUDY OF THE OCCURRENCE AND PERSISTENCE OF PATHOGENS AND INDICATOR ORGANISMS IN REFUSE–SLUDGE COMPOSTING

CONTRACT NO. PH 86–67–112
PH 86–68–143

CONTRACTOR
East Tennessee State University
Department of Microbiology
Johnson City, Tenn. 37601

COST: $81,550 (estimated)
PROJECT START: June 1967
PROJECT END: May 1969

PROJECT DIRECTOR
William L. Gaby

OBJECTIVE: To study the occurrence and persistence of pathogens and indicator organisms in refuse–sludge composting.

APPROACH: Methods will be selected or developed to permit a study of the quantitative recovery of pathogens and indicator organisms. In order to determine their survival during the windrow process of composting refuse and various refuse–sewage sludge mixtures, samples from the compost or from especially prepared inserted samples will be taken from the windrows at specified times throughout the composting process.

PROGRESS TO DATE: Determinations have been made on raw or partially digested sludge, refuse, and refuse–sludge mixtures for the following: total bacterial counts at 35 C and 55 C for aerobes and anaerobes, total coliforms, *Escherichia coli*, salmonella, staphylococci-coagulase positive, *Streptococcus faecalis*, enteroviruses, pathogenic fungi, and human and animal parasites. A total of 615 samples have been analyzed to date.

This study has shown that the pathogen destruction is achieved in the inner portion of the windrow where temperatures range from 149 F to 163 F. It has also demonstrated that moisture control is important.

The contract has been extended to enable further modification of methods, isolation techniques, and the sensitivity for recovering organisms. The final report will be evaluated and considered for publication by the Bureau of Solid Waste Management. Details on the availability of the report can be obtained from the Bureau Office of Information.

COMPOSTING DEWATERED SEWAGE SLUDGE

CONTRACT NO. PH 86-67-103

CONTRACTOR
The Eimco Corporation
537 West Sixth South
Salt Lake City, Utah 84103

COST: $67,695 (estimated)
PROJECT START: March 1967
PROJECT END: July 1968

PROJECT DIRECTOR
A. A. Kalinske

OBJECTIVE: To study the composting of dewatered sewage sludge using a "mechanical type" composter in order to provide a means of processing the sewage sludge and other organic types of sludge into an end product that is odor free, devoid of insect life and pathogens, easy to handle, and useful for agricultural purposes.

APPROACH: Using facilities at Salt Lake City's sewage treatment plant, a pilot plant was constructed by Eimco Corporation. Thickened sludge was dewatered on a vacuum filter and conveyed to the mechanical composter, which was equipped with stirring, aerating, sampling, and measuring devices. Tests were conducted to determine: (1) the limits of moisture content of sludge cake; (2) necessary recycle ratios; (3) processing capacity for the sewage sludge in terms of volume and time; (4) required air; (5) temperature in various parts of the composting mass; (6) chemical and physical composition of the final product; (7) influence of varying feed rates; (8) limits of batch feeding; (9) composition of gas evolved from the composting mix; (10) influence of chemicals used for sludge conditioning before vacuum filtration. In addition, under a subcontract, the University of Utah School of Medicine made studies on the destruction of pathogenic bacteria, fungi, cysts, and viruses in the composted material.

SUMMARY OF PROGRESS: Characteristics of the mechanical composted dewatered sewage sludge have been observed and recorded. Weight volume, moisture, and solids reduction have been observed at several retention times. Conspicuous effects appeared to be that of drying (80–88 percent reduction in water), effective destruction of the organic matter by the thermophilic organisms, and the destruction of pathogenic organisms inoculated into the system. Routine observations have been made on temperature at various places throughout the composter, the thoroughness of mixing of the material, the rate of gaseous emissions, and the identification of some of these gases. Various relationships have been established between the rate of air flow into the compost material, the recycling rate, the mixing of the material, and the composting temperature. The final report has been received and is being prepared for publication.

SHELL, G. L., and J. L. BOYD. *Composting dewatered sewage sludge.* Public Health Service Publication No. 1936. Washington, U.S. Government Printing Office, 1969. (In press.)

ABSTRACTING OF SELECTED PERIODICAL LITERATURE

CONTRACT NO. PH 86-67-182
PH 86-68-194

CONTRACTOR
Franklin Institute of the State of Pennsylvania
Benjamin Franklin Parkway
Philadelphia, Pa. 19103

COST: $75,335 (estimated)
PROJECT START: June 1967
PROJECT END: June 1969

PROJECT DIRECTOR
Alec Peters

OBJECTIVE: To screen, catalog, index, and abstract published literature in the solid wastes field to enable the Solid Waste Information Retrieval System to maintain an updated, annotated bibliography of solid waste management information.

APPROACH: All issues of a selected list of 149 U.S. journals and 34 foreign language journals covering the 1964–1967 period are being reviewed. The articles are screened, cataloged, indexed, and 250-word abstracts are prepared that emphasize solid waste aspects of the article. Screening includes a review of every issue. The selection of relevant material will be made from all appropriate articles published during the contract period.

SUMMARY OF PROGRESS: Approximately 2,000 abstracts have been submitted. Many of the abstracted articles will appear in the annotated bibliography of 1964 solid waste management literature, which is being prepared for publication. The contract was extended in order to update and maintain a current annotated bibliography for calendar year 1968.

A STUDY OF COMPOSTING TECHNOLOGY AND COMPOST UTILIZATION IN EUROPE

CONTRACT NO. PH 86-67-13

CONTRACTOR
Samuel A. Hart
720 Anderson Road
Davis, Calif. 95616

COST: $10,000 (estimated)
PROJECT START: August 1966
PROJECT END: June 1967

PROJECT DIRECTOR
Samuel A. Hart

OBJECTIVE: To investigate composting and other biodegradation techniques as practiced in Europe and to evaluate the utilization of the products.

APPROACH: Information and data was gathered by on-site investigation and personal interviews with key personnel. Comparative descriptions of plant processes, refuse handling techniques, and ways that compost is utilized from the various operations was obtained. Data was collected and analyses made of capital and operating costs for various processes and marketability of the products. In addition to the technical evaluations, the author considered related health aspects, areas of needed future research, and methods used to monitor processes.

SUMMARY OF PROGRESS: A report entitled, *Solid Waste Management/Composting; European Activity and American Potential,* was submitted in fulfillment of the contract. It contains detailed findings of the European survey and proposals for future American research and practice. Chapters are devoted to the survey of 14 European composting plants, compost utilization in Europe, European research in compost manufacture and use, the potential for composting and compost utilization in the United States, and recommendations for U.S. composting research. The report has been published and is available from the Bureau of Solid Waste Management.

HART, S. A. *Solid waste management/composting; European activity and American potential.* Public Health Service Publication No. 1826. Washington, U.S. Government Printing Office, 1968. 40 p.

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SOLID WASTES MANAGEMENT IN GERMANY; REPORT OF THE U.S. STUDY TEAM VISIT, JUNE 25–JULY 8, 1967

CONTRACT NO. PH 86-67-257

CONTRACTOR
Samuel A. Hart
720 Anderson Road
Davis, Calif. 95616

COST: $2,000
PROJECT START: July 1967
PROJECT END: August 1967

PROJECT DIRECTOR
Samuel A. Hart

OBJECTIVE: To observe and study German practices in solid waste management, research, and technology in order to determine their applicability in the United States.

APPROACH: Eight American engineers and scientists spent 2 weeks on a waste management study tour in Europe. After attending the Ninth Congress of the International Association of Public Cleansing technical meeting in Paris, they then toured Germany in order to evaluate garbage and refuse handling, and disposal facilities. The team visited the cities of Berlin, Munich, Rosenheim, Frankfurt, Schweinfurt, Düsseldorf, and Duisburg.

SUMMARY OF PROGRESS: A detailed report of the U.S. study team visit has been submitted in fulfillment of the terms of this contract. This report has been published by the Bureau of Solid Waste Management and is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20204. The report discusses the findings of the study team under the general headings of characteristics and changes in European solid wastes, domestic refuse storage and collection, landfilling, composting, and incineration.

HART, S. A. *Solid wastes management in Germany; report of the U.S. study team visit, June 25–July 8, 1967.* Public Health Service Publication No. 1812. Washington, U.S. Government Printing Office, 1968. 18 p.

FEASIBILITY STUDY ON THE DISPOSAL OF POLYETHYLENE PLASTIC WASTE

CONTRACT NO. PH 86-67-274

CONTRACTOR
IIT Research Institute
10 West 35th Street
Chicago, Ill. 60616

COST: $63,485 (estimated)
PROJECT START: June 1967
PROJECT END: June 1968
Extended to: September 1968

PROJECT DIRECTOR
Gene Zerlaut

OBJECTIVE: To determine by laboratory and pilot testing the feasibility of alternate methods of disposal of polyethylene plastic wastes.

APPROACH: This project is being conducted by the staff of Polymer Research at Illinois Institute of Technology Research Institute, and is being carried out in two phases as follows:

Phase I will be a literature survey covering: (1) plastic reclamation; (2) present methods of plastic disposal; (3) basic properties of resins and components; (4) analytical and identifying methods for resins, components, and degradation products; (5) possible modifications of present plastic disposal methods; (6) the use of stress cracking to reduce plastic waste bulk; (7) plastic waste disposal products and their effect on air and waste pollution.

Through laboratory and pilot testing, the feasibility of alternate methods of disposal of polyethylene plastic wastes will be determined as Phase II. Economics, safety, ease of operation, and other factors governing potential community acceptance of alternate methods will be carefully evaluated.

PROGRESS TO DATE: The literature survey has been completed. The research on the treatment of several polyethylenes by some liquid oxidants, some gaseous oxidants, and by thermal and catalytic degradation, particularly that of photolysis, has been completed. Numerous tests on these plastics, before and after treatment, have been conducted. Studies of the effects of fuming nitric acid treatment on polyethylene plastics and the amount of residual nitrogen content following treatment are under way. The thermal studies will be continued on the pretreated materials with particular interest focused on calorimetry and differential thermal analysis methods. The applicability of high energy radiation as a method of effective degradation of polyethylene is also being investigated using ^{60}Co as the radiation source.

ECONOMIC EVALUATION OF CONVERTING SOLID WASTE MATERIALS INTO YEAST

CONTRACT NO. PH 86-67-204

CONTRACTOR
Ionics, Inc.
65 Grove Street
Watertown, Mass. 02172

COST: $30,000
PROJECT START: June 1967
PROJECT END: February 1968

PROJECT DIRECTOR
Daniel L. Brown

OBJECTIVE: To determine whether various kinds of solid wastes—mixed and unmixed—can compete as sources of yeast for animal protein additives and other uses, and whether the size of the probable market for yeast warrants developing processes for the conversion of solid wastes.

APPROACH: An economic evaluation of the overall concept of converting solid waste materials into yeast was made. The study included economic consideration of solid wastes as raw material, including questions of abundance and stable supply, locational cost and costs of preparation, ease of hydrolysis, and chemical composition of hydrolysate. Various types of solid wastes investigated included mixed municipal wastes, waste paper, and agricultural process wastes.

SUMMARY OF PROGRESS: The final report, containing six sections with appendices, has been received by the Bureau and will be published. Possible raw materials available from solid wastes for the production of yeast were classified into three groups (newsprint, bagasse, and mixed refuse), and the cost of hydrolysis for each material is compared with the prices of soy, cotton seed, fish, and animal protein. Possible markets for any large quantities of yeast produced from solid wastes are discussed.

MELLER, F. H. *Conversion of organic solid wastes into yeast; an economic evaluation.* Public Health Service Publication No. 1909. Washington, U.S. Government Printing Office, 1969. (In press.)

STUDY OF THE COST OF MUNICIPAL INCINERATION

CONTRACT NO. PH 86-68-184

CONTRACTOR
Louis Koenig Research
Route 10, Box 108
San Antonio, Tex. 78213

COST: $32,570 (estimated)
PROJECT START: June 1968
PROJECT END: June 1969

PROJECT DIRECTOR
Graham B. Knight

OBJECTIVE: To obtain comparative cost and engineering audits of municipal incineration as actually incurred and actually practiced in order to obtain data upon which to project the cost of future incinerator installations.

APPROACH: Data will be collected on those elements of available plant information that make up the cost of incineration. The unit investments, pertinent design factors, and various other components of incinerator cost will be statistically analyzed from selected model type plants. The data and information obtained will provide public officials, planners, economists, etc., with the level of costs to be anticipated and the ranges and central tendencies to be expected in wholesale studies of solid waste economics.

STUDY OF THE HEALTH EFFECTS OF AIR POLLUTION RELATED TO SOLID WASTES

CONTRACT NO. PH 86-66-129

CONTRACTOR
Benjamin Linsky
1360 Anderson Avenue
Morgantown, W. Va. 26505

COST: $3,000
PROJECT START: May 1966
PROJECT END: October 1966

PROJECT DIRECTOR
Benjamin Linsky

OBJECTIVE: To obtain a thorough evaluation of the relationships of air pollution, health, and solid waste disposal practices.

APPROACH: An in-depth literature search, including law literature and judicial findings, was conducted on health-related aspects of air pollution and solid wastes. The information obtained was used to integrate current knowledge about solid wastes, air pollution, and the relationships of air pollutants originating from solid wastes to various health problems.

SUMMARY OF PROGRESS: A report entitled "Health Effects of Air Pollution Related to Solid Waste" was submitted in fulfillment of the contract. The findings included in the report are in four general subject areas: (1) general and specific information on solid waste management problems; (2) specific solid waste disposal methods; (3) air pollutants both as they relate to solid wastes and in general; (4) the health effects of air pollution resulting specifically from organized and disorganized solid waste handling and disposal. Fifty-two specific health effects are included. The report is intended for Bureau use. No publication is planned.

CONSTRUCTION OF CONTINUOUS CHEMICAL–MICROBIAL PILOT PLANT TO PRODUCE EDIBLE PROTEINS FROM CELLULOSIC WASTES

CONTRACT NO. PH 86-68-152

CONTRACTOR
Louisiana State University
Department of Chemical Engineering
Baton Rouge, La. 70803

COST: $74,230
PROJECT START: June 1968
PROJECT END: June 1969

PROJECT DIRECTORS
Claydon W. Callihan
Ralph W. Pike

OBJECTIVE: To demonstrate that cellulosic wastes can be continually processed and converted to single-cell protein, and that this is economically advantageous.

APPROACH: A pilot plant will be designed and constructed to process various types of municipal, industrial, and agricultural cellulosic wastes, converting these materials to digestible protein. The plant will not only handle multiple feeds but will demonstrate the economic feasibility of growing microorganisms on cellulosic substrates as a means of upgrading these wastes into useful products.

A batch process for the chemical-microbial conversion of cellulose wastes to single-cell protein has been developed. An aerobic, mesophilic, cellulolytic organism isolated from the soil of sugarcane fields has been found capable of solubilizing filter paper and bagasse during a 5-day incubation period. The single-cell protein produced in the batch fermentation compares favorably with other reported single-cell proteins, soybean protein, and the ideal amino acid pattern of the Food and Agriculture Organization. An integral part of the operation will include the methods for complete evaluation of: the yields from any substrate; the residence time in the reactor required by any particular alkali pretreatment and substrate; the aeration requirement for the most economic growth rates the fertilizer requirements; the BOD and COD demands of the feed and product; and the equipment to determine the best harvesting techniques for the microorganism grown on the cellulose substrate.

It is hoped that the production and marketing data will result in an informative report.

STUDY OF PACKAGING MATERIALS AND WASTE DISPOSAL

CONTRACT NO. PH 86-67-114

CONTRACTOR
Midwest Research Institute
425 Volker Boulevard
Kansas City, Mo. 64110

COST: $67,470 (estimated)
PROJECT START: March 1967
PROJECT END: September 1968

PROJECT DIRECTOR
Arsen J. Darnay, Jr.

OBJECTIVE: To determine the present packaging material mix and its relation to disposal of the materials. To project the trends in packaging materials types and volumes to the year 1976 together with their potential technical and economic effects on disposal. To suggest means of effecting changes in packaging technology and use so as to mitigate the problems of disposal.

APPROACH: A product-by-product analysis of packaging materials, covering historical development and a 10-year forecast (to 1976) of material composition and configurations, competitive relations, industry sources and factors affecting the markets, quantities consumed, and quantities reclaimed, reused, or disposed of as waste, was undertaken. Attempts were made to describe the technological and convenience factors affecting packaging materials development and packaging waste generation problems to give an analysis of packaging material disposability in terms of combustibility, compactibility, degradability, return for reuse, and salvage. Means for alleviating the waste disposal problems arising from the projected 1976 volumes and types of packaging materials were also developed and evaluated.

SUMMARY OF PROGRESS: The final report discusses the outlook for packaging materials for 1966 to 1976 by presenting a general overview of packaging followed by an analysis of general trends affecting its future. Separate sections are devoted to each basic packaging material category with a forecast summary. The disposability of packaging material is considered, as well as various actions that might be taken to mitigate the solid waste problems arising from the use of packaging materials. The report is being published. Distribution to the general public will be by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20204.

ADDENDUM: The contract has been extended to cover the nonpackaging paper and paperboard products in a supplementary report.

DARNAY, A. J., JR., and W. FRANKLIN. *The role of packaging in solid waste management, 1966 to 1976.* Public Health Service Publication No. 1855. Washington, U.S. Government Printing Office, 1969. 205 p.

INVESTIGATION OF HEALTH-RELATED DIFFERENCES IN MICROBIOLOGICAL QUALITY OF PRODUCTS FROM VARIOUS TYPES OF RENDERING PLANTS

CONTRACT NO. PH 86-67-20
PH 86-68-126

CONTRACTOR
University of Minnesota
College of Veterinary Medicine
St. Paul, Minnesota 55455

COST: $60,265 (estimated)
PROJECT START: August 1966
PROJECT END: June 1969

PROJECT DIRECTOR
Benjamin S. Pomeroy

OBJECTIVE: To determine health-related differences in the microbiological quality of products from various types of rendering plants and factors responsible for such differences.

APPROACH: During the first year studies were made in four plants selected on the basis of plant construction, plant sanitation, type of animal waste products used, and by-products manufactured. Bacteriological examinations were made on finished products with particular attention to samples collected during various processing stages. In addition, the operational feasibility and costs of adjustments necessary to eliminate salmonellae organisms in finished products were to be evaluated. The effects of various plant designs and operational factors were considered as they relate to the microbiological quality and safety of rendering plant products. A new contract emphasizing controlled laboratory investigation to determine minimum and optimum conditions for growth of potential pathogens in rendered materials with an evaluation of the more complex automated plants is now underway.

SUMMARY OF PROGRESS: The first year progress report indicates that rendered products are often contaminated with salmonellae and enterpathogenic strains of *Escherichia coli*. The studies revealed, however, that the pathogens often could not be correlated with visual observation of plant sanitation and that contamination of products in larger plants with more complex, difficult-to-clean equipment was more frequently observed.

LOKEN, K. I., K. H. CULBERT, R. E. SOLEE, and B. S. POMEROY. Microbiological quality of protein feed supplements produced by rendering plants. *Applied Microbiology*, 16(7) : 1002–1005, July 1968.

LOKEN, K. I. Sanitation and thermal destruction of salmonellae in feed and feed ingredients. Presented at the course, Epidemiology and Control of Salmonellosis, Trenton, April 24, 1968. 7 p.

SOLEE, R. E., K. I. LOKEN, and B. S. POMEROY. Monitoring animal, fish, and poultry by-products for the presence of salmonella. St. Paul. University of Minnesota. mimeo. 11 p.

SOLEE, R. E., K. I. LOKEN, and B. S. POMEROY. The application of sanitation in rendering plants. St. Paul, University of Minnesota. mimeo. 31 p.

PROTOCOL FOR UNDERTAKING A RESEARCH PROGRAM FOR ON-SITE SOLID WASTE REMOVAL FROM HIGH-RISE RESIDENTIAL STRUCTURES

CONTRACT NO. PH 86–66–171

CONTRACTOR
National Academy of Sciences
National Research Council
Building Research Advisory Board
2101 Constitution Avenue, NW
Washington, D.C. 20418

COST: $10,000 (estimated)
PROJECT START: June 1966
PROJECT END: June 1967

PROJECT DIRECTOR
Robinson Newcomb

OBJECTIVE: To undertake systems analysis of on-site refuse systems and establish a protocol for a study relating to the development of acceptable methods of refuse disposal that will lead quickly to improvements in on-site refuse collection and disposal systems for high-density residential developments.

APPROACH: The protocol was developed by the appointment to the Building Research Advisory Board of an *ad hoc* committee composed of scientific, professional, and technical authorities. The committee met regularly to develop a firmly established protocol for the study with provisions for follow-up reviews in order to evaluate the advantages and disadvantages of the several systems proposed for waste disposal. The committee's responsibility covered the following areas: (1) selection of equipment to be installed and studied; (2) determination of kinds of data to be obtained; (3) establishment of an experimental program for years II and III; (4) provision of guidance to Committee staff; (5) review and analysis of data collected; (6) preparation and approval of all reports—complete with conclusions and recommendations—emanating from the study, including interim reports covering the efforts of each of the first two years, and a final phase-I report due at conclusion of the third-year effort.

SUMMARY OF PROGRESS: A final report was accepted in June 1967 containing the requested protocol for undertaking a research program for on-site solid waste removal from high-rise residential structures. The report contains a detailed description of the problem, and from a long list of selected problems, proposes four areas for intensive study covering the "life-cycle" of solid wastes from generation to disposal. Recommendations have been accepted and research is currently under way under Contract No. PH 86–67–167 to carry out the required research program. Information from the report is available through the Bureau Office of Information.

SOLID WASTE RESEARCH IN THE APPLICATION OF ON-SITE REFUSE STORAGE, COLLECTION, AND REDUCTION SYSTEM FOR HIGH-RISE RESIDENTIAL STRUCTURES

CONTRACT NO. PH 86-67-167

CONTRACTOR
National Academy of Sciences
National Research Council
Building Research Advisory Board
Division of Engineering
2101 Constitution Avenue, NW
Washington, D.C. 20418

COST: $160,575 (estimated)
PROJECT START: June 1967
PROJECT END: December 1968

PROJECT DIRECTOR
Robert M. Dillon

OBJECTIVE: To study currently available equipment and techniques for handling solid wastes from high-rise multi-family structures, with consideration of user needs and acceptance, public health concerns, and performance. A secondary objective is to study the interface between the on- and off-site system.

APPROACH: Collection of data on "as is" conditions related to inhabitants; composition, weight, and volume of wet and dry refuse; efficiency of existing on-site refuse disposal systems; on-site storage facilities; fly (adult), rodent, and other vermin counts; operating time and costs for handling refuse; composition and volume of sewage through flow rates in the structure drain and waste system. Modifications necessary for the installation of refuse disposal systems will be prepared with pilot tests being run and programs established for automatic data processing, reduction, and analysis.

SUMMARY OF PROGRESS: Agreement has been reached with the Public Housing Authority, New Haven, Conn., regarding the use of three Housing Authority structures for the purpose of carrying out the field laboratory research. Collection of data is under way on "as is" conditions, including the extent of contribution to air pollution by existing equipment; personnel and power requirements; costs; efficiency and effectiveness; owner/tenant/custodian–janitor acceptance of existing systems; weight, volume, and composition of generated refuse; composition and volume of waste flowing through structure drainage lines; and degree of vermin infestation associated with existing systems. In addition, preliminary plans are being prepared for the installation of refuse reduction equipment.

AN EXAMINATION OF THE FEASIBILITY OF THE RECOMMENDATIONS IN THE NAS–NRC PUBLICATION, WASTE MANAGEMENT AND CONTROL

CONTRACT NO. PH 86-67-240

CONTRACTOR
National Academy of Sciences
National Research Council
Division of Engineering
2101 Constitution Avenue, NW
Washington, D.C. 20418

COST: $140,580 (estimated)
PROJECT START: June 1967
PROJECT END: January 1969

PROJECT DIRECTOR
John C. Kohl

OBJECTIVE: To obtain advice on the relevance to the work of the Bureau of Solid Waste Management of the recommendations in the NAS–NRC publication *Waste Management and Control* (1966), along with advice on research needed for developing indices and parameters for implementation of a systems concept.

APPROACH: A committee on solid waste management was established within the National Research Council's Division of Engineering, for correlating environmental needs, particularly those related to air and water pollution, with solid waste disposal. The committee will advise on: (1) the feasibility of the recommendations of the NAS–NRC report *Waste Management and Control* as they relate to the handling and disposal of solid wastes, including those from urban, industrial, and agricultural sources, and residues resulting from liquid and gaseous waste systems; (2) whether other courses of action similar to the above are feasible or should be studied; (3) a priority rating for the feasible courses of action under (1) and (2) above, and the estimated costs of implementing these actions; (4) criteria for the selection of demonstration sites for actual studies or demonstrations of the recommendations; (5) research and development efforts in the solid waste field which are necessary for developing the required indices and parameters for implementation of a systems concept.

SUMMARY OF PROGRESS: Interim progress reports covering work performed during the first year of the contract have been submitted to the Bureau of Solid Waste Management. It is expected that the contract will be completed on schedule. Recommendations will be made in the final report, which will be published as a Public Health Service Publication and will be available from the Superintendent of Documents, U.S. Government Printing Office.

AN ACTION PROGRAM FOR REGIONAL SOLID WASTE MANAGEMENT SYSTEMS

CONTRACT NO. PH 86-67-290

CONTRACTOR
National Association of Counties
Research Foundation
1001 Connecticut Avenue, NW
Washington, D.C. 20036

COST: $212,950
PROJECT START: June 1967
PROJECT END: June 1970

PROJECT DIRECTOR
Bernard F. Hillenbrand

OBJECTIVE: To provide local governmental leaders with nontechnical comprehensive guides that explore all aspects of solid waste management and will assist local government in the development of regional solid waste management systems.

APPROACH: The work is divided into three phases and covers a 3-year period. The initial phase was concerned with the development of management and informational tools in order to develop a national concept of comprehensive regional solid waste management systems that will help guarantee environments favorable to health and assure the preservation of natural beauty. A series of community action guides for solid waste management systems have been developed and distributed covering: (1) legislation, (2) management approaches, (3) planning, (4) organization, (5) construction and operations, (6) financing, (7) types of assistance available, (8) communication methods and techniques, (9) staffing requirements, and (10) plans of action.

In phase two a national workshop on solid waste management was planned, developed, and conducted. Attendees at the workshop reviewed drafts of the guides and were helped to understand the urgency of the need for local governmental agencies to initiate comprehensive and operational systems. This National Solid Wastes Management Workshop was held in September 1968.

Phase three will encompass the planning, development, and conduct of 20 regional solid waste management institutes to acquaint governmental agencies with the action guides.

SUMMARY OF PROGRESS: Final guides are being published and distributed—one guide per month in 1969, through the *American County Government* magazine. In addition, copies of the guides will be distributed at the regional solid waste management institutes.

STUDY OF SOLID WASTE MANAGEMENT IN THE FOOD PROCESSING INDUSTRY

CONTRACT NO. PH 86-68-138

CONTRACTOR
National Canners Association
1950 Sixth Street
Berkeley, Calif. 94710

COST: $57,120
PROJECT START: June 1968
PROJECT END: November 1969

PROJECT DIRECTOR
Walter A. Mercer

OBJECTIVE: To obtain basic information on the national, geographical, and seasonal distribution of solid wastes generated in the food canning industry, with an evaluation and descriptions of current methods, techniques, and costs in the management of such wastes. The information obtained will help in determining the relative magnitude of disposal problems related to this source and enable factual and equitable efforts toward the development of recycling, utilization, and disposal methods.

APPROACH: Current agricultural and industrial census reports, records and reports of various national and state food processing organizations and associations, and selected publications were searched to obtain and summarize available information. In addition, detailed interviews were conducted at selected food processing plants to collect information on specific processes and process streams. Data were obtained on individual food products and food product classes, time of production, and volume of waste generated, characteristics of the waste solids, cost of the processing or disposal, environmental problems created, and the plant operations giving rise to the quantity and characteristics of the solid wastes generated. The information obtained is being organized and compiled for use by agencies responsible for planning and integrating solid waste management systems.

DETERMINATION OF AIRBORNE EMISSIONS FROM MUNICIPAL INCINERATORS

CONTRACT NO. PH 86-67-62
PH 86-68-121

CONTRACTOR
New York University
College of Engineering and Science
Research Division
University Heights
New York, N.Y. 10463

COST: $80,000 (estimated)
PROJECT START: December1966
PROJECT END: March 1969

PROJECT DIRECTOR
Arrigo Carotti

OBJECTIVE: To investigate and determine the kinds and quantities of emissions that are discharged from incinerators in the process of incinerating municipal solid waste.

APPROACH: Gaseous effluents were sampled from the stack discharges of municipal incinerators in the New York City metropolitan area. These samples were analyzed to determine chemical composition and variations in composition. Sampling of stack effluents during each of the four seasons permitted determination of possible seasonal variations. An analysis of effluents from the same incinerator was made as often as necessary to collect detailed data on all possible materials emitted with identification and quantification of specific organic compounds; effluents potentially toxic to humans received special attention. Sampling and analyses were done on effluents from three other municipal incinerators different in construction and design. In all cases data were recorded on: (1) average general composition of the refuse feed; (2) the incinerator operating conditions; (3) total gaseous effluents discharged; (4) rate of discharge of the stack effluents; (5) composition of the quench water and residue.

SUMMARY OF PROGRESS: A literature survey and data review on airborne emissions from municipal incinerators has been completed and submitted to the Bureau of Solid Waste Management. This report contains the annotated bibliography of the literature surveyed, a summary report of the present knowledge on airborne emissions from municipal incinerators, and recommendations for further study. Detailed sampling and analysis of selected components is now underway, with publication planned following termination of the studies.

DETERMINATION OF SOIL INDEX PROPERTIES OF COVER MATERIAL AND SANITARY LANDFILLS

CONTRACT NO. PH 86-68-196

CONTRACTOR
H. C. Nutting Company
4120 Airport Road
Cincinnati, Ohio 45226

COST: $13,550 (estimated)
PROJECT START: June 1968
PROJECT END: June 1969

PROJECT DIRECTOR
H. C. Nutting

OBJECTIVE: To determine the index properties of cover material from sanitary landfills within the United States in order to develop guidelines for the safe and efficient operation of sanitary landfills in different geographical locations.

APPROACH: Soil samples will be analyzed and classified according to the Unified Soil Classification System. The number of tests to be performed will depend on the initial test results, soil variations per sample, and soil variations per landfill. The soil descriptions will be included as part of the test results.

PATENT SEARCH OF ON-SITE REFUSE HANDLING DEVICES FOR COMMERCIAL, RESIDENTIAL, APARTMENT, AND OFFICE BUILDINGS

CONTRACT NO. PH 86–67–95

CONTRACTOR
Stephen B. Olmsted
2881 West Ritchie Parkway
Rockville, Md. 20850

COST: $1,750
PROJECT START: March 1967
PROJECT END: May 1967

PROJECT DIRECTOR
Stephen B. Olmsted

OBJECTIVE: To obtain a thorough and consistent inventory and catalog of potential refuse handling devices.

APPROACH: Over 3 million patents were searched for devices that were related to solid wastes. Patent examiners were consulted and selected patent lawyers were questioned regarding specific devices for solid waste handling.

SUMMARY OF PROGRESS: A detailed report covering the classes searched, a list of the U.S. and foreign patents found and notes for future searches were submitted to the Bureau of Solid Waste Management in fulfillment of the contract. The list of patents has been collated in 12 subject folios with the patents arranged by date of issuance. Three hundred and sixty-one U.S. and 62 foreign patents were found to be of value. The patents show means of performance and not the many adaptations. The report is available for Bureau use. Publication of the entire patent search is not planned; however, selected patents were published in a single volume, which is available from the Bureau of Solid Waste Management.

CONNOLLY, J. A., ed. *Abstracts; selected patents on refuse handling facilities for buildings.* Public Health Service Publication No. 1793. Washington, U.S. Government Printing Office, 1968. 320 p.

AN APPRAISAL OF CURRENT REFUSE COLLECTION AND DISPOSAL PRACTICES IN WESTERN EUROPE

CONTRACT NO. PH 86-67-6

CONTRACTOR
Casimir A. Rogus
37-22 223rd Street
Bayside, N.Y. 11361

COST: $450
PROJECT START: August 1965
PROJECT END: September 1965

OBJECTIVE: To report on solid waste practices observed during on-site investigations of refuse disposal facilities in Europe that might be applicable in the United States.

APPROACH: A literature review, questionnaires, interviews with engineering officials, and on-site investigation at 11 major cities, where most of the latest European concepts in the field of solid waste were developed, was used to obtain information on current disposal practices in Europe. The information was evaluated and compared with current U.S. practices.

SUMMARY OF PROGRESS: A report entitled "An Evaluation of Refuse Collection and Disposal Practices in Western Europe" was accepted by the Bureau of Solid Waste Management in fulfillment of the terms of this contract. Included in the report are descriptions of the characteristics of European refuse, the variety of collection equipment in use, and the present practices of utilization and disposal. Incineration as a primary refuse handling process is described in terms of basic design, performance, costs, air pollution devices, waste heat recovery, in-plant operations, and residue salvage procedures. Photographs and figures are used to describe the practices. No publication is planned, although the report is available for use by Bureau personnel.

TECHNICAL FEASIBILITY OF AN AIR CLASSIFICATION PROCESS TO SEPARATE SELECTED DRY SOLID WASTE MATERIALS

CONTRACT NO. PH 86-68-157

CONTRACTOR
Stanford Research Institute
333 Ravenswood Drive
Menlo Park, Calif.

COST: $20,000 (estimated)
PROJECT START: June 1968
PROJECT END: December 1968

PROJECT OFFICER
Lester P. Berriman

OBJECTIVE: To obtain a preliminary determination of the technical feasibility of utilizing air classification to process or treat selected types of nonhomogeneous, dry, solid wastes.

APPROACH: A detailed test program was developed, based on the characteristics of the wastes selected and on the purposes for which air classification might be employed for processing these wastes. Appropriate experiments were conducted using an experimental pilot-scale air classifier modified to facilitate the handling of solid materials. Five different types of waste were tested with the study limited to the technical aspects of the air classifier operation. The experiments were designed to determine both the limitations and the advantages of the air separation processes.

STUDY AND EVALUATION OF TECHNICAL AND ECONOMIC FACTORS OF POLYMER WASTE DISPOSAL

CONTRACT NO. PH 86-68-160

CONTRACTOR
Stanford Research Institute
333 Ravenswood Drive
Menlo Park, Calif.

COST: $63,280 (estimated)
PROJECT START: June 1968
PROJECT END: February 1969

PROJECT DIRECTOR
Chester W. Marynowski

OBJECTIVE: To assess the polymer waste disposal problem and to evaluate alternative approaches to polymer waste utilization.

APPROACH: Personal interviews were used to obtain information on: (1) the sources, amounts, and forms of polymer wastes generated; (2) the availability of selected organic wastes that could be combined with the polymers to make some disposal methods more feasible; (3) disposal methods in use or under investigation. Important technical factors of alternative disposal methods were thoroughly evaluated and each proposed method was rated technically against established performance criteria. Most of the research and development was directed toward the disposal of polyethylene and polypropylene wastes.

Recommendations will be made on the best disposal methods capable of immediate industrial application. The disposal process with the highest potential for economic solution will be developed and demonstrated through the pilot-plant stage to obtain data for the designs and preliminary cost of industrial units.

ENGINEERING STUDY OF A ONE-MAN COLLECTION SYSTEM

CONTRACT NO. PH 86-67-248

CONTRACTOR
Ralph Stone and Co., Inc.,
Engineers
10954 Santa Monica Boulevard
Los Angeles, Calif. 90025

COST: $80,200 (estimated)
PROJECT START: June 1967
PROJECT END: June 1968

PROJECT DIRECTOR
Ralph Stone

OBJECTIVE: To obtain basic information about various types of collection systems and to provide a comparative analysis of one-man systems and other established collection techniques in order to determine if a one-man system can improve the efficiency of operation from a financial standpoint and the reduction of hazards and nuisance problems.

APPROACH: The overall refuse collection evaluation was accomplished by a comprehensive study of the available one-man-operated equipment and its use in comparison with two-man- and three-man-operated collection vehicles. A thorough inventory of collection equipment suitable for one-man crew operation was made, and a municipal survey involving field studies within a number of selected communities that employ various types of collection systems provided a comparative analysis between one-man systems and others as related to technical feasibility, economic applicability, and operational practicability, including the human factors, of one-man collection systems.

SUMMARY OF PROGRESS: The collection of field data and data analysis is finished, and the final report has been received. It will be published and available from the Bureau of Solid Waste Management.

RALPH STONE AND COMPANY, INC., ENGINEERS. *A study of improved refuse collection systems comparing one-man with multi-man crews; a final report.* Public Health Service Publication No. 1892. (In press.)

SOLID WASTE MANAGEMENT STUDY OF THE AUTOMOTIVE ASSEMBLY INDUSTRY

CONTRACT NO. PH 86-68-212

CONTRACTOR
Ralph Stone and Co., Inc.,
Engineers
10954 Santa Monica Boulevard
Los Angeles, Calif. 90025

COST: $55,880 (estimated)
PROJECT START: June 1968
PROJECT END: June 1969

PROJECT DIRECTOR
Ralph Stone

OBJECTIVE: To obtain basic technical information concerning the quality and quantity of solid waste generated by the automotive assembly industry in order to identify real or potential problems of solid waste management and to develop guidelines for acceptable solid waste management practices.

APPROACH: Analyses will be made of storage and collection practices with emphasis on system efficiency, economics, and aesthetics. The waste generated will be characterized to identify real or potential problems in disposing of solid wastes by current disposal methods, and an analysis will be made of past, present, and future trends of the solid wastes generated with special or possible emergency management problems identified. The solid waste production will be correlated with a readily available and universal parameter of the automotive assembly industry.

ANALYTICAL INVESTIGATION OF NEW CHEMICAL CONCEPTS FOR WASTE PLASTIC UTILIZATION

CONTRACT NO. PH 86-68-206

CONTRACTOR
TRW Inc.
One Space Park
Redondo Beach, Calif. 90278

COST: $99,930 (estimated)
PROJECT START: June 1968
PROJECT END: June 1969

PROJECT DIRECTOR
Robert S. Ottinger

OBJECTIVE: To determine by computer simulation whether waste plastics can be converted to economically significant products by reactions with various reagents in a high-temperature reactor.

APPROACH: Computer programs simulating chemical reactions between waste plastics, namely polyethylene, polystyrene, and polyvinylchloride, and various reagents such as oxygen, water, hydrogen, ammonia, and others selected on the basis of cost, availability, and estimated reactivity with the selected plastics, will be used to obtain information as to the thermodynamic and kinetic properties of the reactions. When all of the necessary information is collected and placed on the program input tapes, the analysis will be conducted by: (1) calculating rapidly and inexpensively the product distribution for a broad range of initial compositions and temperature and pressure conditions; (2) examining the outputs for economically significant product concentrations and potentially harmful air or water pollutants. Further calculations will be made to quantitatively determine the effects of the reaction conditions on the concentrations of important products. The data resulting from these analyses will be interpreted to develop relationships describing disposal costs, reactants used with the plastics, value of products and reactor complexity, and control capability requirements.

SOLID WASTE MANAGEMENT AND RUBBER REUSE POTENTIAL IN THE RUBBER INDUSTRY

CONTRACT NO. PH 68-68-208

CONTRACTOR
Uniroyal Chemical
Division of Uniroyal, Inc.
Elm Street
Naugatuck, Conn. 06770

COST: $47,170 (estimated)
PROJECT START: June 1968
PROJECT END: June 1969

PROJECT DIRECTOR
M. Frank Roninger

OBJECTIVE: To obtain information and data on (1) the quality and quantity of solid waste generated by the rubber industry; (2) the present state-of-the-art of utilization of discarded rubber and rubber products; (3) the present practices, needs, and problems of solid waste management within the industry.

APPROACH: Questionnaires and interviews are being used to obtain basic data on the rubber products, scrap rubber, and reclaimed rubber industry, to determine the problems associated with each segment of the industry. The study must produce basic technical information concerning solid waste management within the rubber manufacturing and reclaim industries in a form that will help establish industrial solid waste guidelines and reference material for the industry, governmental agencies, and industries concerned with solid waste management. Separate studies are required to identify and evaluate the technical feasibility of various unique uses of waste rubber and to investigate and analyze the feasibility of various postulated means of broadening the market for scrap rubber.

DEVELOPMENT OF A METHOD OF PREDICTION OF SOLID WASTE CHARACTERISTICS

CONTRACT NO. PH 86-68-97

CONTRACTOR
URS Corporation
1811 Trousdale Drive
Burlingame, Calif. 94011

COST: $27,355 (estimated)
PROJECT START: January 1968
PROJECT END: January 1969

PROJECT DIRECTOR
Myron B. Hawkins

OBJECTIVE: To develop a technique for predicting the characteristics of solid wastes in urban areas. The model to be developed will identify materials used and consumed by a given community and will use input/output techniques to determine the quantity of waste to be expected as well as its physical and chemical composition. This knowledge will enable sanitary engineers, public health officials, and others concerned with solid waste management to plan for future collection and disposal requirements.

APPROACH: Using available economic sources, the contractor is collecting, developing, and formulating selected standard data, descriptors, and functions for input commodities and activities in order to design and develop specifications for a basic waste prediction model. The model will be tested manually in a relatively small community to evaluate the general performance of the model.

SUMMARY OF PROGRESS: A major portion of the work performed to date has been the identification of sources of information and the collection and compilation of input information. Much of this work has centered around collecting information on the size of various activities and the amount of goods and materials which flow in and through these activities. In addition, criteria have been determined for the selection of the test community.

SURVEY OF EUROPEAN REFUSE COLLECTION PRACTICES

CONTRACT NO. PH 86-67-34

CONTRACTOR
A. M. Westling
Post Office Box 5177
Eugene, Oreg. 97403

COST: $600
PROJECT START: October 1966
PROJECT END: March 1967

PROJECT DIRECTOR
A. M. Westling

OBJECTIVE: To investigate solid waste collection practices in selected European countries in order to report on on-site solid waste handling practices in apartment buildings, schools, and other locations generating large volumes of refuse and the relationships of urban planning to planning for solid waste collection and disposal.

APPROACH: Interviews with public officials and on-site observation were used to obtain data on European collection practices. This reconnaissance type of evaluation was used to identify variations in practices and to select locations that might warrant further investigation. General observations were made on the volume and the types of refuse generated, and significant trends were noted.

SUMMARY OF PROGRESS: A report summarizing investigations and observations on solid waste collection practices in England, Scotland, West Germany, Denmark, Sewden, and The Netherlands has been accepted by the Bureau of Solid Waste Management in fulfillment of the contract. These notes on European refuse collection practices include detailed descriptions of containers for refuse collection, refuse collection and community design, and automatic refuse collection systems. Copies have been made available for Bureau use. No provisions will be made for general distribution.

PREPARATION OF A PROTOCOL FOR CODIFICATION AND DATA GATHERING SURVEY TO BE USED BY STATE PLANNING AGENCIES

CONTRACT NO. PH 86-67-12
PH 86-67-43

CONTRACTOR
William A. Xanten
3355 Military Road, NW
Washington, D.C. 20015

COST: $2,250
PROJECT START: July 1966
PROJECT END: November 1966

PROJECT DIRECTOR
William A. Xanten

OBJECTIVE: To obtain fundamental guidelines and procedures for State agency surveys to enable the attainment of established objectives as progressively and uniformly as possible.

APPROACH: Past survey forms and the types of information obtained by their use were examined. The personal experience of the investigators was used to modify and develop the required information.

SUMMARY OF PROGRESS: A report entitled "Codification and Data Gathering Surveys for State Planning Agencies" has been accepted by the Bureau of Solid Waste Management. This report proposes fundamental guidelines for in-depth data gathering surveys. Suggested forms to be used for basic data information on the general survey and site investigations of community solid waste practices were included. The report was prepared for use by Bureau personnel and will not be published or distributed.

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Summaries of Bureau of Solid Waste Management

C O N T R A C T S

July 1, 1968--June 30, 1969

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NATIONAL INDUSTRIAL SOLID WASTE MANAGEMENT STUDY--THE PRINTING AND PUBLISHING INDUSTRY

CONTRACT NO. CPE 69-6

CONTRACTOR
Battelle Memorial Institute
505 King Avenue
Columbus, Ohio 43201

COST: $73,484
PROJECT START: May 1969
PROJECT END: July 1970

PROJECT DIRECTOR
Rufus C. Short

OBJECTIVE: To study and evaluate the solid waste management practices of the publishing and printing industry, SIC 271, 272, 273, and 275.

APPROACH: Information and data will be collected on the following items of the publishing and printing industry on a national basis: (1) total number of industrial plants, employment, capital value of the plants, and quantities and types of products produced; (2) past development and production patterns within the industry indicating present trends, new technology, and future development; (3) flow diagrams for the basic production processes; (4) location of the industries with particular notation of production centers in the country; (5) identification of the quantity (weight) and quality (character) of solid waste generated; (6) correlation of solid waste production with a readily available universal parameter of the plant; (7) identify and analyze the current storage collection and disposal practices of the industry; (8) amount of money being spent for storage, collection, treatment, and disposal of solid waste for the industry; (9) analysis of the future trends of solid waste management within the industry and factors that might influence them, such as reuse, etc.

The methodology to collect the information and data will consist of a literature review and a variety of different types of field interviews. Following the data collection phase, the information will be analyzed and evaluated.

SUMMARY OF PROGRESS: The first 2 mo of this project have been devoted to a literature review, grouping of plants by SIC numbers and location, and development of an interview guide.

CPU-400 PROGRAM MANAGEMENT AND SYSTEMS ENGINEERING

CONTRACT NO. CPE 69-100

CONTRACTOR
Combustion Power Company, Inc.
Stanford Industrial Park
2625 Hanover Street
Palo Alto, California 94304

COST: $175,832
PROJECT START: August 1968
PROJECT END: July 1969

PROJECT DIRECTOR
Richard D. Smith

OBJECTIVE: The purpose of this proposal is to provide program management and systems engineering that may be used, together with the results of the key subscale experiments (PH 86-68-198) as they become available, and to refine the preliminary design of the jet engine incinerator to the point where the final or detailed design can be started.

APPROACH: Overall management for the CPU-400 program will be provided. A systems design study will be conducted on six subsystems of the CPU-400: solid waste handling, hot gases, turbo electric, controls, residue handling, and facility. Studies will be made on materials corrosion and exhaust gas contamination. Turbine compatibility tests will be defined and economic and application studies will be undertaken. The program plan will be updated as new information becomes available.

SUMMARY OF PROGRESS: The design of the CPU-400 has been updated to include an improved solid waste handling subsystem and hot gas subsystem. The new design features acceptance of bulky refuse and increased storage capacity. Two 40 ton/hr shredders are planned for the system. With the exception of the carousel, all design features will be evaluated in the 1/10-scale pilot plant (TCT). The pilot plant, which is ready for construction in September 1969, will generate 1,000 KW of electric power from municipal refuse. Application studies have shown that the CPU-400 might incinerate raw sewage sludge for less than $0.9/1,000 gal of treated effluent; that, when linked with a multi-stage flash desalting unit, the system might produce 2,500,000 gal of fresh water per day from sea water for less than $0.28/1,000 gal; and that the unit might be capable of producing activated char that could be used for processing sewage water at less than $0.10/1,000 gal of treated effluent.

BUREAU OF SOLID WASTE MANAGEMENT ANNUAL FILM REPORT: PROGRESS IN SOLID WASTE MANAGEMENT THROUGH RESEARCH, DEVELOPMENT, AND DEMONSTRATION

CONTRACT NO. CPE 69-111

CONTRACTOR
Stuart Finley, Inc.
3428 Mansfield Road
Falls Church, Virginia 22041

COST: $100,475
PROJECT START: June 1969
PROJECT END: June 1971

PROJECT DIRECTOR
Stuart Finley

OBJECTIVE: To develop film reports on solid waste research, development, and demonstration activities to serve the Bureau's basic responsibility for improving solid waste management practice in the United States through dissemination of technical information.

APPROACH: Two separate 16mm color, sound motion picture films will be produced that document selected planning, demonstration, research and training grants, and research contracts; all funded by the Bureau of Solid Waste Management.

One of the films is to be designed primarily for showing to solid waste management professionals, including but not limited to managers, planners, and technicians, as well as public officials. This film will be 45 min in length and more technically oriented than the second film.

A 23-min film will be designed to produce an interesting, logically developed film to entertainingly inform the lay public about the most recent advances in solid waste management.

SUMMARY OF PROGRESS: Planning conferences have been held to select the 15 to 20 projects that will be featured in the film reports.

STUDY TO DETERMINE THOSE FACTORS INFLUENCING CITIZENS' ATTITUDES AND RESPONSES TO FACTORS AND SOLUTIONS REGARDING SOLID WASTE PROBLEMS

CONTRACT NO. CPE 69-107

CONTRACTOR
General Systems Industries, Inc.
Del Amo Financial Center
Torrance, California 90503

COST: $82,622
PROJECT START: May 1969
PROJECT END: April 1970

PROJECT DIRECTOR
Barry Jensen

OBJECTIVE: To investigate those psychometric factors that influence human behavior, with regard to proposed solutions to solid waste systems, and to determine the present attitudes of citizens to these problems.

APPROACH: An attitude and opinion survey will be conducted that is representative of the entire population. The socio-economic characterization of the respondents as well as identity of the participants initiating, supporting, opposing, and negotiating solid waste management decisions will be made.

Attitudes of citizens toward solid waste problems and their current solutions will be determined and related to background factors such as sex, age, occupation, income, etc. A determination will be made of how these attitudes change under the influence of new information, persuasive intervention, and incentives.

The successful and unsuccessful establishment of solid waste disposal sites and public opposition to the operation of existing sites will be examined through an analysis of public and private records of the decision-making process.

SUMMARY OF PROGRESS: A draft has been completed of an in-depth questionnaire that will be used to probe attitudes of citizens in areas experiencing controversy over solid waste problems. Twenty tentative interview communities have been selected, preparatory to a final selection of ten of them to be visited in this project.

NATIONAL INDUSTRIAL SOLID WASTE MANAGEMENT STUDY--THE ELECTRICAL HOME APPLIANCE INDUSTRY

CONTRACT NO. CPE 69-4

CONTRACTOR
Louis Koenig Research
Route 10, Box 108
San Antonio, Texas 78213

COST: $31,720
PROJECT START: May 1969
PROJECT END: May 1970

PROJECT DIRECTOR
Louis Koenig

OBJECTIVE: To study and evaluate the solid waste management practices of the electrical home appliance industry, SIC 363.

APPROACH: Information and data will be collected on the following items of the electrical home appliance industry on a national basis: (1) total number of industrial plants, employment, capital value of the plants, and quantities and types of products produced; (2) past development and production patterns within the industry indicating present trends, new technology, and future development; (3) flow diagrams for the basic production processes; (4) location of the industries with particular notation of production centers in the country; (5) identification of the quantity (weight) and quality (character) of solid waste generated; (6) correlation of solid waste production with a readily available universal parameter of the plant; (7) identify and analyze current storage, collection, and disposal practices of the industry; (8) amount of money being spent for storage, collection, treatment, and disposal of solid waste for the industry; (9) analysis of the future trends of solid waste management within the industry and factors that might influence them, such as reuse, etc.

This data and information will be gathered by a literature review, questionnaires mailed to a sample of industrial plants, and personal interviews. The final phase of the project will consist of data evaluation and analysis.

SUMMARY OF PROGRESS: During the first 2 mo of this project, information was gathered on the total number of plants, location, employment, capital value, and production. The contractor began the development of a questionnaire to be used for data collection from a selected group of establishments.

NATIONAL INDUSTRIAL SOLID WASTE MANAGEMENT STUDY--THE DRUG INDUSTRY

CONTRACT NO. CPE 69-7

CONTRACTOR
Litton Systems, Inc.
Applied Science Division
2003 East Hennepin Avenue
Minneapolis, Minnesota 55413

COST: $80,000
PROJECT START: May 1969
PROJECT END: July 1970

PROJECT DIRECTOR
Joe Goeppner

OBJECTIVE: To study and evaluate the solid waste management practices of the drug industry, SIC 283.

APPROACH: Information and data will be collected on the following items of the drug industry on a national basis: (1) total number of industrial plants, employment, capital value of the plants, and quantities and types of products produced; (2) past development and production patterns within the industry indicating present trends, new technology, and future development; (3) flow diagrams for the basic production processes; (4) location of the industries with particular notation of production centers in the country; (5) identification of the quantity (weight) and quality (character) of solid waste generated; (6) correlation of solid waste production with a readily available universal parameter of the plant; (7) identify and analyze current storage, collection, and disposal practices of the industry; (8) amount of money being spent for storage, collection, treatment, and disposal of solid waste for the industry; (9) analysis of the future trends of solid waste management within the industry and factors that might influence them, such as reuse, etc.

All data and information will be gathered by a literature review, a questionnaire mailed to a selected group of individual plants, and field interviews. The final phase of this project will be data analysis and evaluation.

SUMMARY OF PROGRESS: During the first 2 mo, the literature review, numerical structuring of the plants by SIC groups, and statistical sample sizing for questionnaire and field interviews was completed. Liaison was established with the Pharmaceutical Manufacturers Association, and with their assistance, a draft of the questionnaire for the surveys was developed.

ECONOMIC STUDY OF SALVAGE MARKETS FOR COMMODITIES ENTERING THE SOLID WASTE STREAM

CONTRACT NO. CPE 69-3

CONTRACTOR
Midwest Research Institute
425 Volker Boulevard
Kansas City, Missouri 64110

COST: $103,193
PROJECT START: May 1969
PROJECT END: May 1970

PROJECT DIRECTOR
Arsen J. Darnay, Jr.

OBJECTIVE: To provide an economic evaluation of the marketing of recoverable solid waste material.

APPROACH: The contractor will define, evaluate, and project the markets for recoverable solid waste materials. An investigation of the market prospects for materials recovered or reclaimed from solid wastes will emphasize three major areas: the structural framework of the market; the influence of prices, price differential, and price volatility on market prospects; and an assessment of the quantitative requirements for recoverable materials. Within municipal operations, data will be sought on salvage quantities, revenue, and costs of present operations. The secondary material markets, including the roles of private enterprise and of nonprofit organizations, will be researched. The technical processes available or required for the separation, recovery, or preparation for resale or reuse will be reviewed. Paper, metals, glass and ceramics, organic materials, and several miscellaneous items will be examined in detail. The study will concentrate in four regional markets and 10 cities.

A catalog of all major municipal salvage operations will be made.

SUMMARY OF PROGRESS: Contact has been made with the contractor of a research study financed by the U.S. Bureau of Mines to ensure coordination in the area of salvage from municipal incinerator residue common to both contracts.

DEVELOPMENT OF A DIGEST OF EXISTING MUNICIPAL, COUNTY, AND REGIONAL SOLID WASTE MANAGEMENT ORDINANCES AND A MODEL SOLID WASTE MANAGEMENT ORDINANCE

CONTRACT NO. CPE 69-114

CONTRACTOR
National Association of Counties
Research Foundation
1001 Connecticut Avenue, N.W.
Washington, D. C. 20036

COST: $33,979
PROJECT START: June 1969
PROJECT END: February 1970

PROJECT DIRECTOR
Mel D. Powell

OBJECTIVE: To prepare a digest of 100 local ordinances to enable political, legal, and technical personnel to understand and compare a variety of approaches to solid waste management. A model solid waste ordinance will be developed to serve as a guide to good practice so that cities and counties can make their own decisions by comparing the examples and the model.

APPROACH: The contractor will collect approximately 400 city, county, and regional ordinances from various sources. These will be categorized according to focus of regulation, i.e., collection, storage, disposal, or all three. A balance will be maintained among ordinances regulating privately and publicly operated systems, covering rural, suburban, and urban areas, and among the various States. The 100-ordinance digest will illustrate the following major areas: (1) general statement of policy and purpose, along with definitions, (2) location and extent of administration responsibility, (3) legislative scope, (4) provision for enforcement.

A model ordinance will be developed and formulated to identify essential characteristic elements. Its format will parallel that of the digest.

CONFERENCE ON THE USE AND DISPOSAL OF SINGLE-USE ITEMS IN HEALTH CARE FACILITIES

CONTRACT NO. CPE 69-102

CONTRACTOR
National Sanitation Foundation
2355 West Stadium Boulevard
P. O. Box 1468
Ann Arbor, Michigan 48106

COST: $5,175*
PROJECT START: October 1969
PROJECT END: May 1969

PROJECT DIRECTOR
Tom S. Gable

OBJECTIVE: To define problems in the use and disposal of single-use items in hospitals, laboratories, professional offices, and similar health care facilities and present possible solutions.

APPROACH: A conference was held at the National Sanitation Foundation, Ann Arbor, Michigan, to review the entire matter of the project objectives. Existing laws and regulations and the literature pertaining to single-use items were reviewed and compiled. The conference reviewed the various types of single-use items presently in use.

SUMMARY OF PROGRESS: The conferees were public health and other regulation officials; representatives from hospitals and other health care facilities; manufacturers of single-use items, pharmaceuticals, and packaging materials; and others having a special knowledge of single-use items or of their use and/or disposal.

During the conference, sessions having representation from each group or discipline were held to discuss their interrelationship to the problems and possible solutions for disposal of single-use items in health care facilities.

National Sanitation Foundation. Use and disposal of single-use items in health care facilities. Monograph No. 6. Ann Arbor, Mich., National Sanitation Foundation, 1969. 64 p.

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* Total cost was $20,700. Additional financial support:
$5,175 Health Facilities Planning and Construction Service, United States Public Health Service
10,350 Manufacturers of Single-Use Items, Containers, and Packaging Materials

INVESTIGATION OF NECESSARY CONDITIONS FOR PROPER DECONTAMINATION AND COMBUSTION OF ORGANIC PESTICIDES AND PESTICIDE CONTAINERS

CONTRACT NO. CPE 69-140

CONTRACTOR
Foster D. Snell, Inc.
29 West 15th Street
New York, New York 10011

COST: $34,251
PROJECT START: June 1969
PROJECT END: April 1970

PROJECT DIRECTOR
M. S. Weinberg

OBJECTIVE: To investigate the necessary conditions for proper decontamination and combustion of organic pesticides by investigating (1) selected oxidizers and combustible binding agents, and (2) combustion characteristics and requirements for container composition.

APPROACH: Each mixture of pesticide and selected combustion aid will be investigated to determine the temperature and rate at which it burns. Combustion gases from this procedure will be examined for degree of conversion to carbon monoxide, carbon dioxide, water, and intermediate organics. Also, binding agents will be applied to such mixtures prior to combustion to test for prevention of mechanical entrainment of the pesticide in the flame convection currents.

Combustion temperatures and characteristics, including completeness of consumption, for common container types will be determined. Based on these studies, requirements for combustible pesticide containers will be developed.

Work done under this contract will be coordinated with and augmented by work being done at Mississippi State and Oregon State Universities.

NATIONAL INDUSTRIAL SOLID WASTE MANAGEMENT STUDY--THE CHEMICAL INDUSTRY

CONTRACT NO. CPE 69-5

CONTRACTOR
The Travelers Research Corporation
250 Constitution Plaza
Hartford, Connecticut 06103

COST: $90,964
PROJECT START: May 1969
PROJECT END: June 1970

PROJECT DIRECTOR
John E. Yocom

OBJECTIVE: To study and evaluate the solid waste management practices of the industrial chemical industry, SIC 281.

APPROACH: Information and data will be collected on the following items of the industrial chemical industry on a national basis: (1) total number of industrial plants, employment, capital value of the plants, and quantities and types of products produced; (2) past development and production patterns within the industry indicating present trends, new technology, and future development; (3) flow diagrams for the basic production processes; (4) location of the industries with particular notation of production centers in the country; (5) identification of the quantity (weight) and the quality (character) of solid waste generated; (6) correlation of solid waste production with a readily available universal parameter of the plant; (7) identify and analyze current storage, collection, and disposal practices of the industry; (8) amount of money being spent for storage, collection, treatment, and disposal of solid waste for the industry; (9) analysis of the future trends of solid waste management within the industry, and factors that might influence them, such as reuse, etc.

The data and information will be gathered by a literature review, a questionnaire mailed to a selected group of industrial plants, and field interviews. The final phase of the project will consist of data evaluation and analysis.

SUMMARY OF PROGRESS: During the first 2 mo, the literature review began and various general and statistical data on the industry were gathered. Liaison was established with the Manufacturing Chemists Association, and development of the questionnaire and field interview format was started.